National Institute of Environmental Health Sciences

Aedes (Stegomyia) aegypti in the continental United States: a vector at the cool margin of its geographic range

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Abstract:

After more than a half century without recognized local dengue outbreaks in the continental United States, there were recent outbreaks of autochthonous dengue in the southern parts of Texas (2004-2005) and Florida (2009-2011). This dengue reemergence has provoked interest in the extent of the future threat posed by the yellow fever mosquito, Aedes (Stegomyia) aegypti (L.), the primary vector of dengue and yellow fever viruses in urban settings, to human health in the continental United States. Ae. aegypti is an intriguing example of a vector species that not only occurs in the southernmost portions of the eastern United States today but also is incriminated as the likely primary vector in historical outbreaks of yellow fever as far north as New York, Philadelphia, and Boston, from the 1690s to the 1820s. For vector species with geographic ranges limited, in part, by low temperature and cool range margins occurring in the southern part of the continental United States, as is currently the case for Ae. aegypti, it is tempting to speculate that climate warming may result in a northward range expansion (similar to that seen for Ixodes tick vectors of Lyme borreliosis spirochetes in Scandinavia and southern Canada in recent decades). Although there is no doubt that climate conditions directly impact many aspects of the life history of Ae. aegypti, this mosquito also is closely linked to the human environment and directly influenced by the availability of water-holding containers for oviposition and larval development. Competition with other container-inhabiting mosquito species, particularly Aedes (Stegomyia) albopictus (Skuse), also may impact the presence and local abundance of Ae. aegypti. Field-based studies that focus solely on the impact of weather or climate factors on the presence and abundance of Ae. aegypti, including assessments of the potential impact of climate warming on the mosquito's future range and abundance, do not consider the potential confounding effects of socioeconomic factors or biological competitors for establishment and proliferation of Ae. aegypti. The results of such studies therefore should not be assumed to apply in areas with different socioeconomic conditions or composition of container-inhabiting mosquito species. For example, results from field-based studies at the high altitude cool margins for Ae. aegypti in Mexico's central highlands or the andes in South America cannot be assumed to be directly applicable to geographic areas in the United States with comparable climate conditions. Unfortunately, we have a very poor understanding of how climatic drivers interact with the human landscape and biological competitors to impact establishment and proliferation of Ae. aegypti at the cool margin of its range in the continental United States. A first step toward assessing the future threat this mosquito poses to human health in the continental United States is to design and conduct studies across strategic climatic and socioeconomic gradients in the United States (including the U.S.-Mexico border area) to determine the permissiveness of the coupled natural and human environment for Ae. aegypti at the present time. This approach will require experimental studies and field surveys that focus specifically on climate conditions relevant to the continental United States. These studies also must include assessments of how the human landscape, particularly the impact

of availability of larval developmental sites and the permissiveness of homes for mosquito intrusion, and the presence of other container-inhabiting mosquitoes that may compete with Ae. aegypti for larval habitat affects the ability of Ae. aegypti to establish and proliferate. Until we are armed with such knowledge, it is not possible to meaningfully assess the potential for climate warming to impact the proliferation potential for Ae. aegypti in the United States outside of the geographic areas where the mosquito already is firmly established, and even less so for dengue virus transmission and dengue disease in humans.

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Resource Description

Exposure :

weather or climate related pathway by which climate change affects health

Temperature

Temperature: Fluctuations

Geographic Feature:

resource focuses on specific type of geography

General Geographical Feature

Geographic Location:

resource focuses on specific location

United States

Health Impact:

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Mosquito-borne Disease

Mosquito-borne Disease: Dengue, Yellow Fever

Population of Concern: A focus of content

Population of Concern:

populations at particular risk or vulnerability to climate change impacts

Low Socioeconomic Status

Resource Type:

format or standard characteristic of resource

Review

Timescale:

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content